91602
new 82-10

COMPLIMENTARY COPY
Please Credit Ontario Hydro Research If
Reproduced In Whole or In Part

ontario hydro
research division

PICKERING NGS 'B' UNIT 8
PHT PRESSURIZING PUMPSET
VIBRATION ANALYSIS

Report No 87-247-K

N.A. Jagan, Engineer
P. Hoogendam, Technologist
Plant Equipment Dynamics Section
Mechanical Research Department

ABSTRACT

A vibration analysis was carried out on the PHT Pressurizing Pumpsets to evaluate the acceptability of pumpset vibration. The analysis indicated that the vibration levels measured on the motors (uncoupled) and on the pumpsets (coupled) while operating at normal recirculation flow are acceptable. At normal full unit load, the velocity vibration level measured on Pumpset #1 is within recommended limits.

job	file	date	report no.
740627-278-552-271	825.4	November 23, 1987	87-247-K

91602
new 82-10

ontario hydro
research division

EXECUTIVE SUMMARY

PICKERING NGS 'B' UNIT 8
PHT PRESSURIZING PUMPSET VIBRATION ANALYSIS

N. Jagan P. Hoogendam
Plant Equipment Dynamics Section
Mechanical Research Department

In April 1987, during a Unit 8 outage, a vibration analysis was carried out on the PHT Pressurizing Pumpsets to evaluate the acceptability of pumpset vibration.

The analysis indicated that the vibration levels measured on the uncoupled motors and on the coupled pumpsets operating at normal recirculation flow are acceptable. At normal full unit load, the velocity vibration level measured on Pumpset #1 is within recommended limits.

It is recommended that normal full unit load shaft displacement levels be obtained on both pumpsets, as soon as the installed shaft displacement monitoring instrumentation is repaired. A full unit load velocity vibration level should also be obtained for Pumpset #2.

job	file	date	report no.
740627-278-552-271	825.4	November 23, 1987	87-247-K

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
2.0	TEST METHOD, INSTRUMENTATION AND MEASUREMENTS	1
2.1	Test Method	1
2.2	Instrumentation	1
2.3	Measurements	2
2.3.1	Overall Vibration Levels	2
2.3.2	Velocity Spectra	2
3.0	RESULTS AND DISCUSSION	2
3.1	Overall Vibration Levels	2
3.2	Velocity Spectra	3
4.0	CONCLUSIONS	3
5.0	RECOMMENDATION	3
	REFERENCES	4
	TABLES	5
	FIGURES	10
	DISTRIBUTION	last page

ontario hydro
research division

To

To: Mr. R.O. Schuelke Jr.
Production Manager
Pickering NGS 'B'

PICKERING NGS 'B' UNIT 8
PHT PRESSURIZING PUMPSET VIBRATION ANALYSIS

1.0 INTRODUCTION

In April 1987, during a Unit 8 outage, a vibration analysis was carried out on the Unit 8 PHT Pressurizing Pumpsets (2 per unit). The objectives were :

1. To evaluate the acceptability of pumpset vibration with respect to specifications and/or industry standards.

2. To make recommendations for corrective action if required.

Each vertical pumpset consists of a Brown Boveri motor rated at 298 kW (400 HP) at 3573 RPM, as well as a Byron Jackson twenty stage pump with a rated capacity of 21.2 L/s (280 Igpm) and a head of 853 m (2800 ft). A more detailed description of the pumpset is given in Appendix A of Reference 1.

2.0 TEST METHOD, INSTRUMENTATION AND MEASUREMENTS

2.1 Test Method

The general pumpset arrangement, measurement locations and directions, as well as the identification used for the report, are shown in Figures 1 and 2. Figure 3 shows a drawing of the pumpset. Vibration measurements were taken on the motor when uncoupled and running. Vibration measurements were also taken on the motor and pump stool base of the coupled pump-motor system, with the pumpset operating at normal recirculation flow.

2.2 Instrumentation

The main components of the instrumentation used in obtaining the measurements are listed in Table 1, and are also discussed in Section 2.3. All vibration signals were recorded on magnetic tape and later analyzed.

2.3 Measurements

2.3.1 Overall Vibration Levels

The overall velocity levels were determined from accelerometer (Bruel & Kjaer Model 4368) signals which were integrated to velocity and then analyzed with a Bently Nevada Digital Vector Filter (DVF 2). The DVF 2 digital vector filter is a peak reading instrument.

Both pumpsets are instrumented with a velocity transducer mounted at the top of the motor in the tangential direction, and a non-contacting displacement transducer directed at the outer diameter of the coupling between the pump and motor (Figs. 1 and 2). With the pumpsets operating at normal recirculation flow, average or overall vibration levels, based on these transducers' signals, were obtained from the Unit computer. With the Unit at full load, the average or overall velocity vibration level displayed by the Unit computer was also obtained for Pumpset #1. No full load vibration readings were available for Pumpset #2.

2.3.2 Velocity Spectra

Velocity spectra were generated by analyzing the accelerometer signals (integrated once) with an Ono Sokki CF 920 dual channel Fast Fourier Transform (FFT) analyzer. Hard copies of the spectra were obtained with a digital plotter (Hewlett-Packard 7470A).

Each velocity spectrum shown in this report is the average of sixteen instantaneous spectra.

3.0 RESULTS AND DISCUSSION

3.1 Overall Vibration Levels

The overall vibration velocity levels measured on Pumpsets #1 and #2 uncoupled motors are summarized in Table 2 and Table 3, respectively. Tables 4 and 5 display the overall vibration velocity levels measured on the coupled pump-motor system for Pumpsets #1 and #2 (operating at normal recirculation flow), respectively.

The results show that the maximum overall velocity occurs at the top of the motor for all the test conditions. The maximum velocity levels range from 2.4 mm/s pk (Pumpset #1 motor uncoupled) to 4.0 mm/s pk (Pumpset #2 pump-motor coupled). These vibration levels are considered acceptable.

With the pumpsets operating at normal recirculation flow, the average or overall velocity vibration levels measured by the permanently installed velocity transducers and displayed on the Unit computer were 2.78 mm/s pk and 1.89 mm/s pk for Pumpsets #1 and #2, respectively. The computer output levels are generally lower than those obtained from the DVF 2 (Tables 4 and 5).

At normal recirculation flow, the Unit computer readout from the shaft displacement transducers on both pumpsets was approximately 0.5 Volts which corresponds to zero shaft displacement. This indicates that the shaft displacement vibration monitoring instrumentation/wiring for both pumpsets is faulty. It has been recommended that the transducers, conditioner cabinets, junction boards, and interconnecting wiring be inspected

for faults and corrected. Reference 2 describes the Pickering NGS 'B' Vibration Monitoring System, as well as a troubleshooting procedure.

At normal full unit load, the average or overall velocity vibration level at the top of Pumpset #1 motor was 2.76 mm/s pk (Unit computer output). This is within the recommended level of 2.82 mm/s pk (full load; level at which motor bearings will have 100,000 hr life)/3/. (The recommended level should be compared to the average velocity level displayed by the Unit computer).

3.2 Velocity Spectra

The velocity spectra obtained on the pumpsets show that the main frequency of vibration is at the 1 X RPM frequency (60 Hz approx.). The velocity levels at this frequency are summarized in Tables 2 to 5. The corresponding velocity spectra figure numbers are also shown in the tables.

On both pumpsets the 1 x RPM vibration is most likely due to some unbalance. However, the levels are not high and rotor balance is considered to be satisfactory.

4.0 CONCLUSIONS

4.1 The vibration levels measured on the uncoupled motors and on the coupled pumpsets operating at normal recirculation flow are considered acceptable. At normal full unit load, the velocity vibration level measured on Pumpset #1 motor is within recommended limits.

4.2 The monitoring instumentation associated with the displacement transducers (includes the sensor, conditioner cabinets, junction boards and interconnecting wiring) for both pumpsets is faulty. It has been recommended that this instrumentation be checked for faults and rectified.

5.0 RECOMMENDATION

Once the shaft displacement monitoring instrumentation is functional, it is recommended that normal full unit load displacement readings be taken on both pumpsets. A normal full unit load overall velocity measurement should also be obtained on Pumpset #2 motor.

Approved by

G.J. Clarke
Manager
Mechanical Research Dept.

Submitted by

N.A. Jagan
Engineer
Plant Equipment Dynamics Section

P. Hoogendam
Technologist
Plant Equipment Dynamics Section

NJ/PH:lg

REFERENCES

1. R.B. Jay, W.D. Morgan. "Pickering NGS 'B', Unit 5, PHT Pressurizing and Circulating Pumpset Vibration". Research Division Report No 84-172-H.

2. R.B. Jay, W.D. Morgan. "Pickering NGS 'B' Vibration Monitoring System". Research Division Report No 83-392-K.

3. R.B. Jay, W.D. Morgan. "Pickering NGS 'B', Unit 8, PHT Pressurizing and Circulating Pumpset Vibration". Research Division Report No 86-311-K.

TABLE 1

INSTRUMENTATION LIST

1.	Accelerometer:	Bruel & Kjaer Model 4368
2.	Velocity Transducer:	Metrix Model 5166-08
3.	Displacement Transducer:	Bently Nevada Cat.# 300-01-00-XX-36-02
4.	Charge Amplifier:	Bruel & Kjaer Model 2635
5.	Dual Channel Analyzer:	Ono Sokki CF 920
6.	Digital Plotter:	Hewlett-Packard Model 7470A
7.	Oscilloscope:	Tektronix Model 2215
8.	Tape Recorder:	Bruel & Kjaer Model 7003F
9.	Filter:	Kron-Hite Model 3343
10.	Vibration Calibrator:	General Radio Model 1557-A
11.	Tracking Filter:	Bently Nevada DVF 2

TABLE 2

PICKERING NGS 'B' UNIT #8 PHT PRESSURIZING PUMPSET #1
VELOCITY VIBRATION LEVELS
MOTOR UNCOUPLED

Measurement Location & Direction	Overall Vibration Level (mm/s peak)	1 X RPM Vibration (mm/s peak)	Fig. No.
Top of Motor			
Loc. #1 (Radial)	2.0 - 2.4	1.42	4
Loc. #2 (Tangential)	1.9 - 2.0	1.49	5
Axial	1.6 - 1.8	0.63	6
Bottom of Motor			
North - South	1.4 - 1.5	1.07	7
East - West	1.0 - 1.2	0.59	8
Axial	1.1 - 1.2	0.52	9

TABLE 3

PICKERING NGS 'B' UNIT #8 PHT PRESSURIZING PUMPSET #2
VELOCITY VIBRATION LEVELS
MOTOR UNCOUPLED

Measurement Location & Direction	Overall Vibration Level (mm/s peak)	1 X RPM Vibration (mm/s peak)	Fig. No.
Top of Motor			
Loc. #1 (Radial)	2.1 - 2.3	1.85	10
Loc. #2 (Tangential)	2.3 - 2.5	2.09	11
Axial	1.1 - 1.3	0.81	12
Bottom of Motor			
North - South	1.0 - 1.2	0.64	13
East - West	1.1 - 1.3	0.78	14
Axial	0.7 - 0.8	0.51	15

TABLE 4

PICKERING NGS 'B' UNIT #8 PHT PRESSURIZING PUMPSET #1
VELOCITY VIBRATION LEVELS
PUMP - MOTOR COUPLED

Measurement Location & Direction	Overall Vibration Level (mm/s peak)	1 X RPM Vibration (mm/s peak)	Fig. No.
Top of Motor			
Loc. #1 (Radial)	3.0 - 3.4	2.57	16
Loc. #2 (Tangential)	2.9 - 3.4	2.33	17
Axial	1.3 - 1.7	0.54	18
Bottom of Motor			
North - South	1.6 - 1.9	1.02	19
East - West	1.9 - 2.2	1.22	20
Axial	0.9 - 1.2	1.21	21
Pump Stool Base			
North - South	1.1 - 1.3	0.71	22
East - West	0.7 - 1.0	0.25	23
Axial	1.0 - 1.3	0.21	24

TABLE 5

PICKERING NGS 'B' UNIT #8 PHT PRESSURIZING PUMPSET #2
VELOCITY VIBRATION LEVELS
PUMP - MOTOR COUPLED

Measurement Location & Direction	Overall Vibration Level (mm/s peak)	1 X RPM Vibration (mm/s peak)	Fig. No.
Top of Motor			
Loc. #1 (Radial)	2.5 - 3.1	1.81	25
Loc. #2 (Tangential)	2.8 - 4.0	2.18	26
Axial	1.5 - 2.0	0.64	27
Bottom of Motor			
North - South	1.7 - 2.3	0.94	28
East - West	1.7 - 2.2	1.09	29
Axial	1.0 - 1.9	0.53	30
Pump Stool Base			
North - South	1.0 - 1.3	0.38	31
East - West	0.7 - 1.1	0.11	32
Axial	0.7 - 1.1	0.16	33

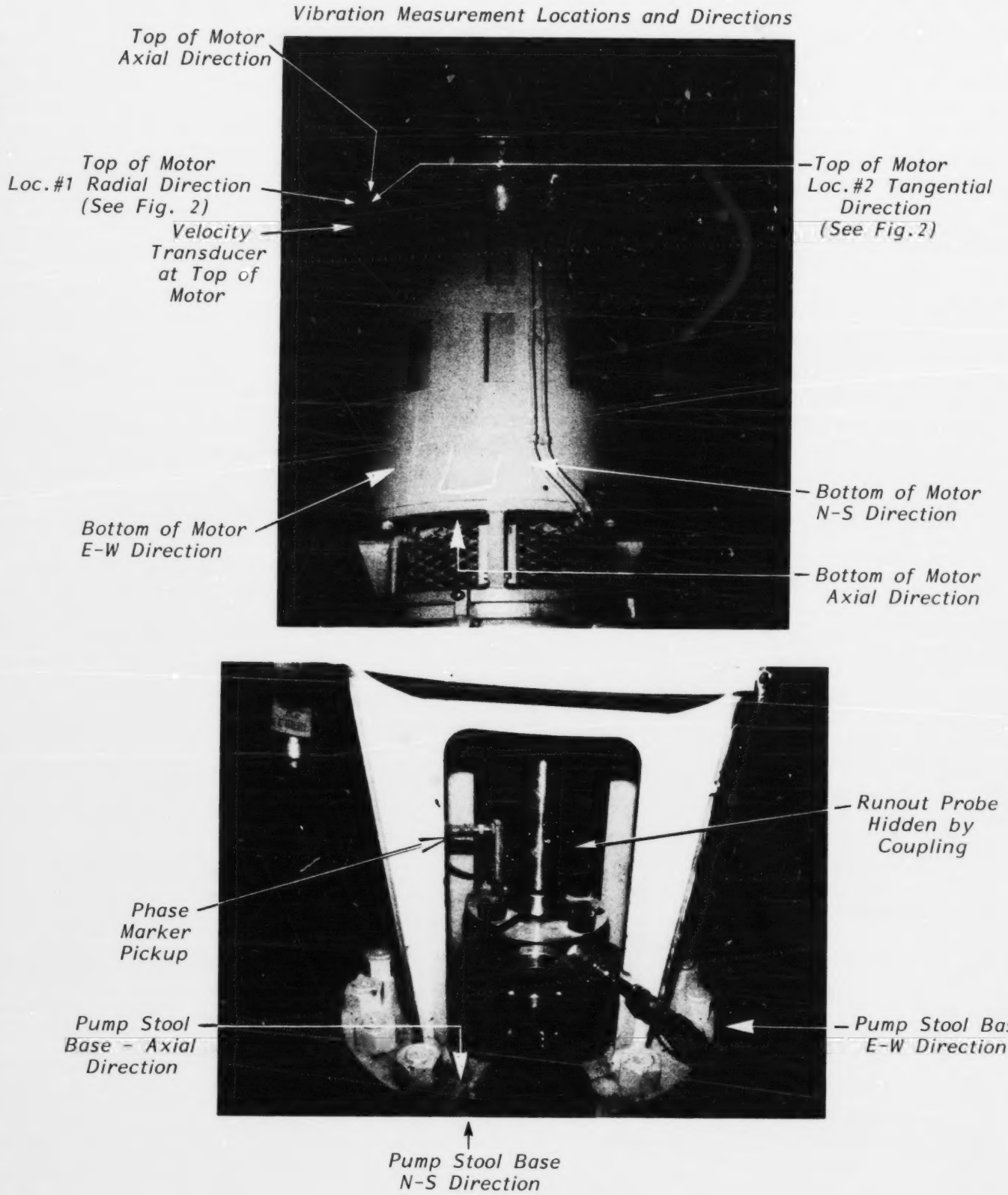

Vibration Measurement Locations and Directions
Top of Motor Axial Direction
Top of Motor Loc.#1 Radial Direction (See Fig. 2)
Velocity Transducer at Top of Motor
Top of Motor Loc.#2 Tangential Direction (See Fig.2)
Bottom of Motor E-W Direction
Bottom of Motor N-S Direction
Bottom of Motor Axial Direction
Runout Probe Hidden by Coupling
Phase Marker Pickup
Pump Stool Base - Axial Direction
Pump Stool Base E-W Direction
Pump Stool Base N-S Direction

FIGURE 1

PICKERING NGS 'B' - PHT PRESSURIZING PUMPSET

167809-RD

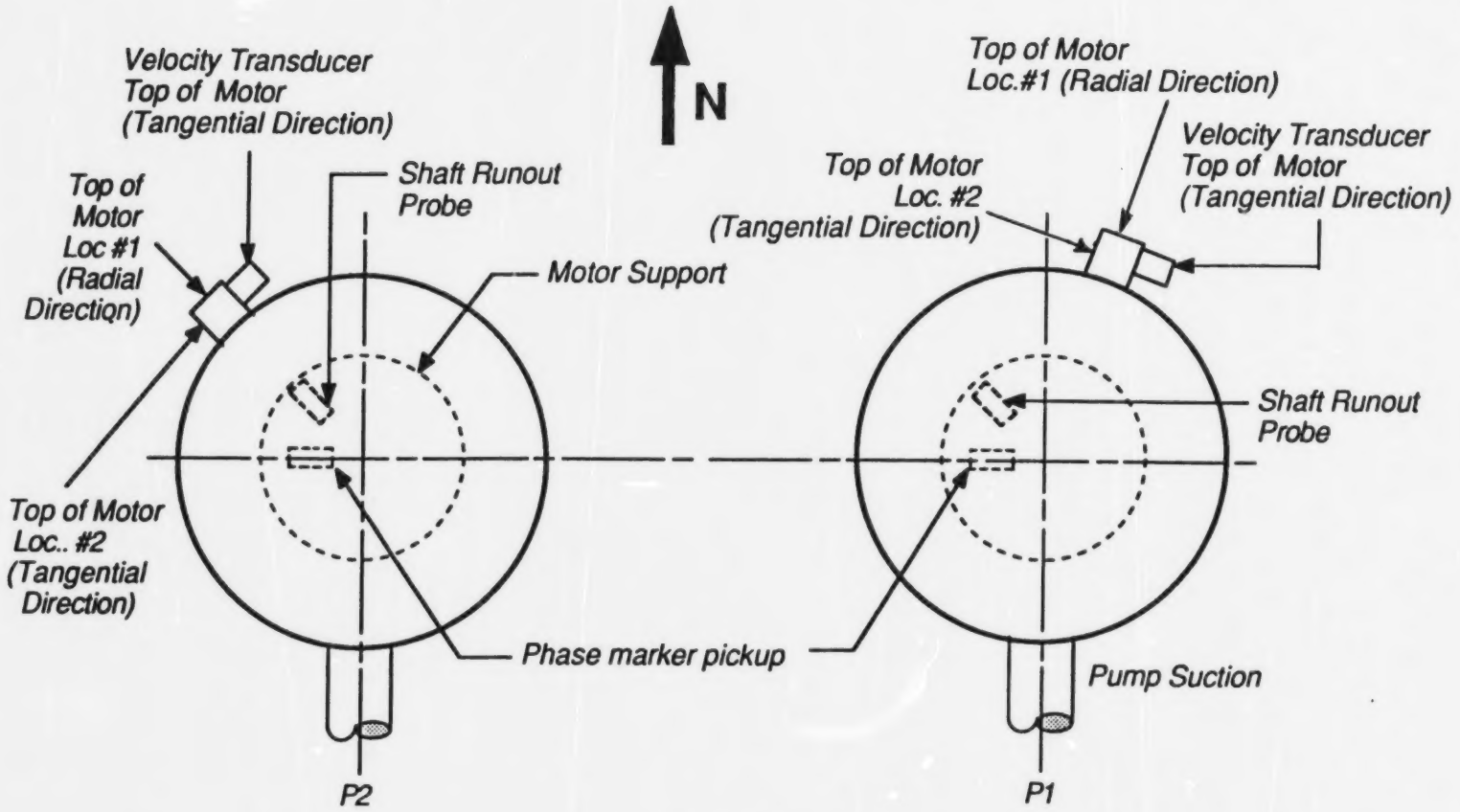


FIGURE 2

PICKERING NGS 'B' - PHT PRESSURIZING PUMPSETS
ORIENTATION OF VIBRATION SENSORS
VIBRATION MEASUREMENT LOCATIONS AND DIRECTIONS

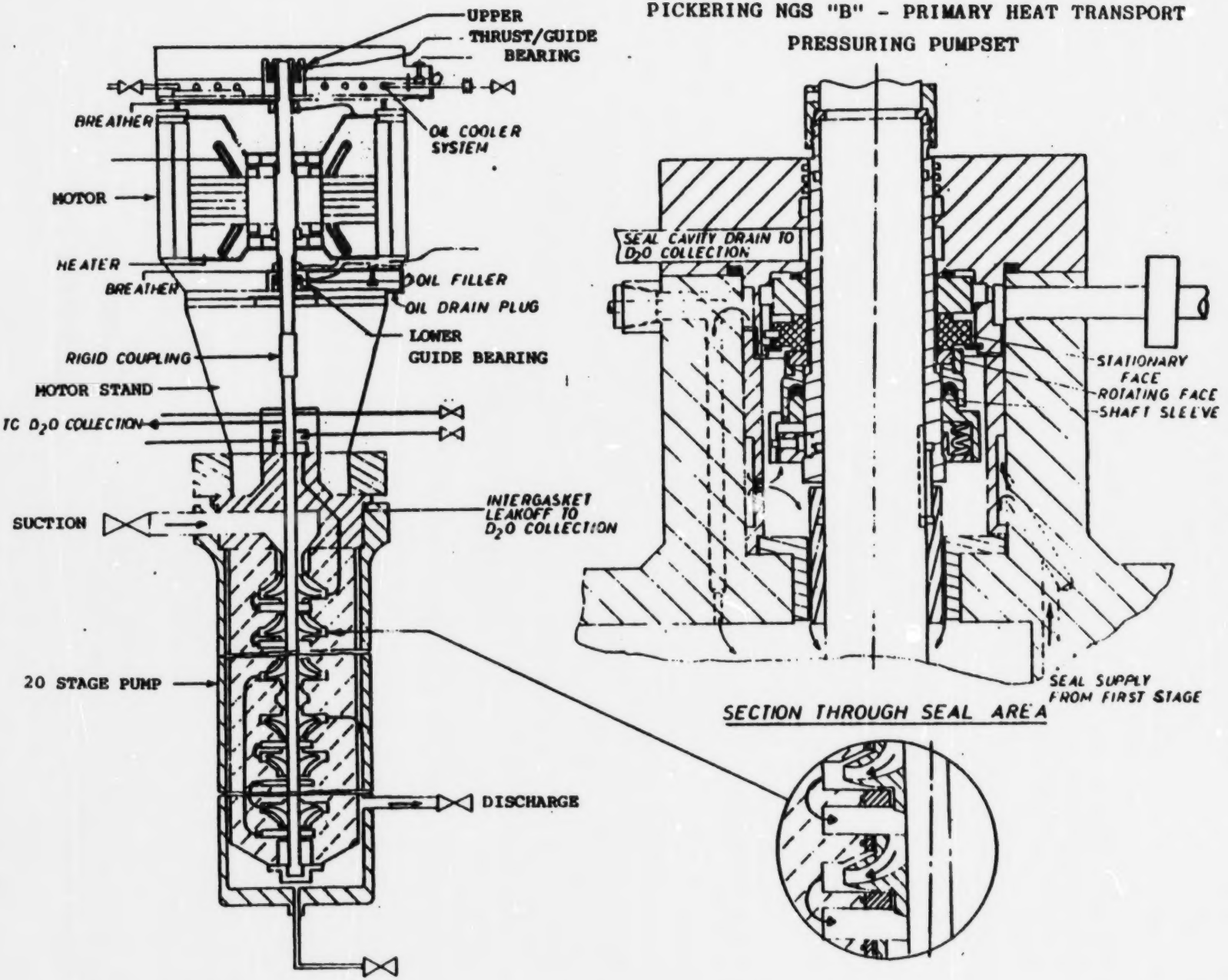
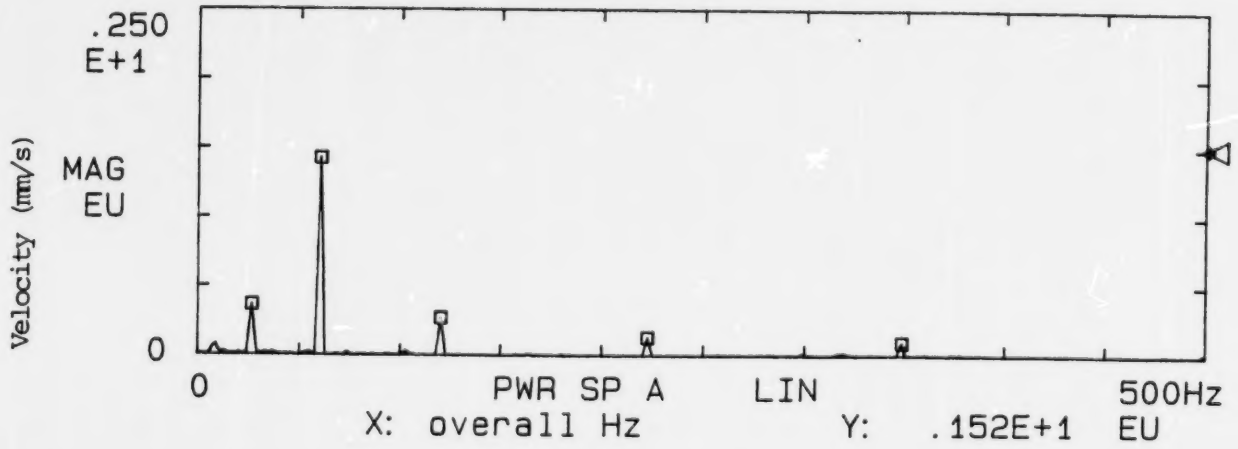

PICKERING NGS "B" - PRIMARY HEAT TRANSPORT
PRESSURING PUMPSET
UPPER
THRUST/GUIDE
BEARING
BREATHER
OIL COOLER
SYSTEM
MOTOR
HEATER
BREATHER
OIL FILLER
OIL DRAIN PLUG
LOWER
GUIDE BEARING
RIGID COUPLING
MOTOR STAND
TC D_2O COLLECTION
SUCTION
INTERGASKET
LEAKOFF TO
D_2O COLLECTION
20 STAGE PUMP
DISCHARGE
SEAL CAVITY DRAIN TO
D_2O COLLECTION
STATIONARY
FACE
ROTATING FACE
SHAFT SLEEVE
SEAL SUPPLY
FROM FIRST STAGE
SECTION THROUGH SEAL AREA

FIGURE 3

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - TOP OF MOTOR CASING VELOCITY
LOC.#1 RADIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#1 UNCOUPLED TOP- (SOFT) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	26.25Hz	.369E+0	EU
2	60.00	.142E+1	
3	120.00	.276E+0	
4	222.50	.139E+0	
5	348.75	.957E-1	
6			
7			
8			
9			
10			



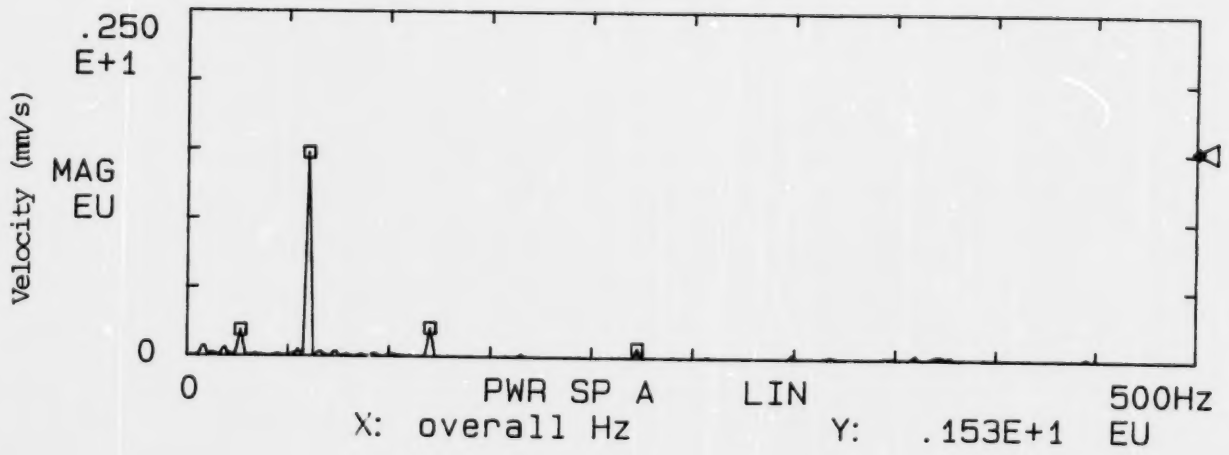
01: 03

FIGURE 4

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - TOP OF MOTOR CASING VELOCITY
LOC.#2 TANGENTIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#1 UNCOUPLED TOP- (HARD) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	26.25Hz	.190E+0	EU (mm/s)
2	60.00	.149E+1	
3	120.00	.217E+0	
4	222.50	.777E-1	
5			
6			
7			
8			
9			
10			



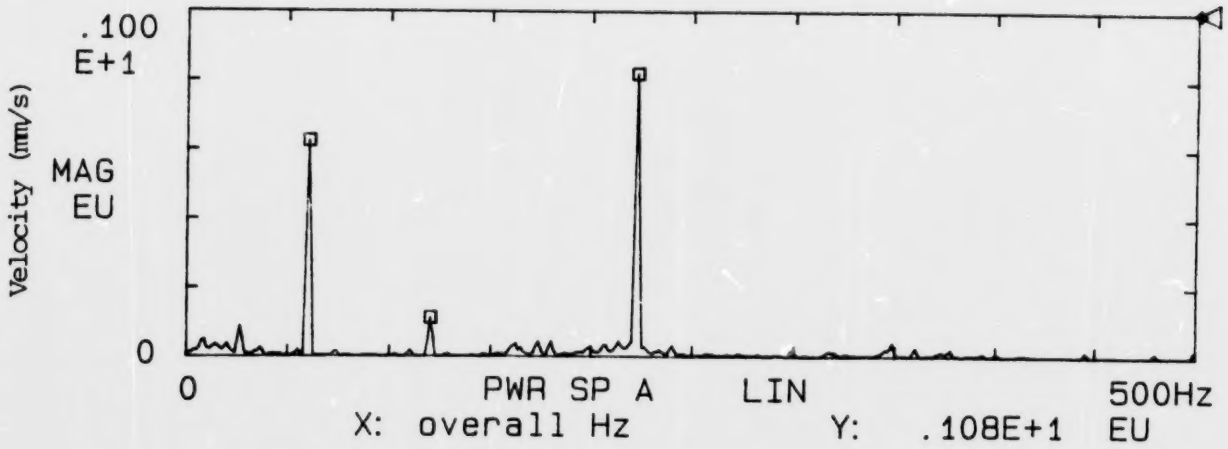
00: 57

FIGURE 5
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - TOP OF MOTOR CASING VELOCITY
AXIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#1 UNCOUPLED TOP- AXIAL VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.629E+0	EU
2	120.00	.115E+0	
3	222.50	.825E+0	
4			
5			
6			
7			
8			
9			
10			



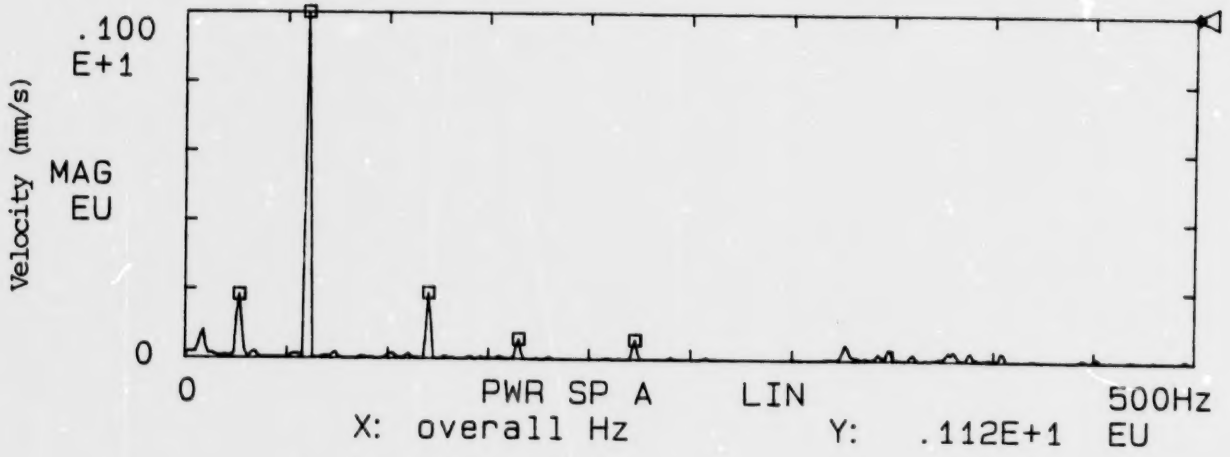
01: 13

FIGURE 6
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - BOTTOM OF MOTOR CASING VELOCITY
N-S DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#1 UNCOUPLED BOT- (SOFT) VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	26.25Hz	.185E+0	EU
2	60.00	.107E+1	
3	120.00	.193E+0	
4	165.00	.619E-1	
5	222.50	.566E-1	
6			
7			
8			
9			
10			



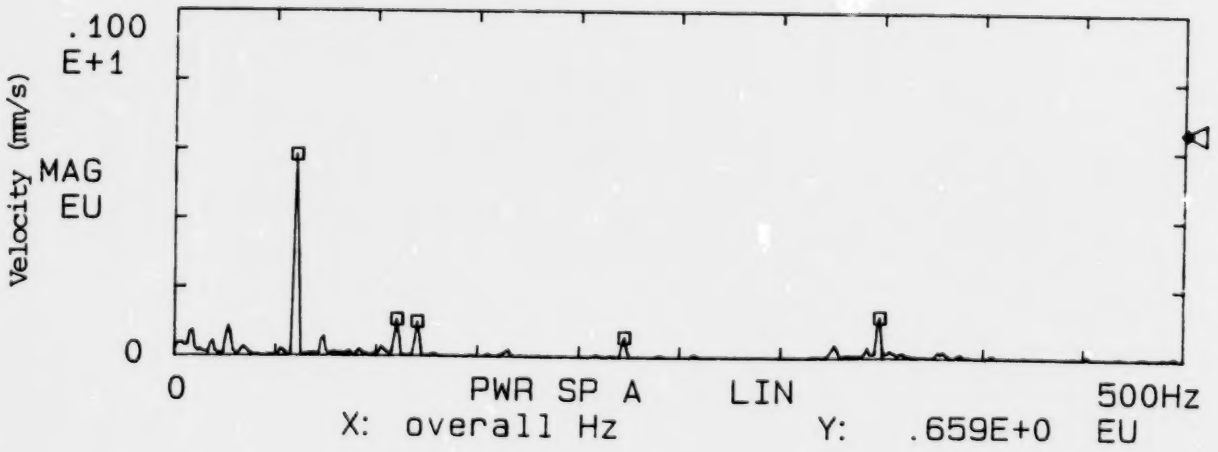
00: 40

FIGURE 7
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - BOTTOM OF MOTOR CASING VELOCITY
E-W DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#1 UNCOUPLED BOT- (HARD) VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.587E+0	EU
2	110.00	.109E+0	
3	120.00	.103E+0	
4	222.50	.624E-1	
5	348.75	.120E+0	
6			
7			
8			
9			
10			



00: 36

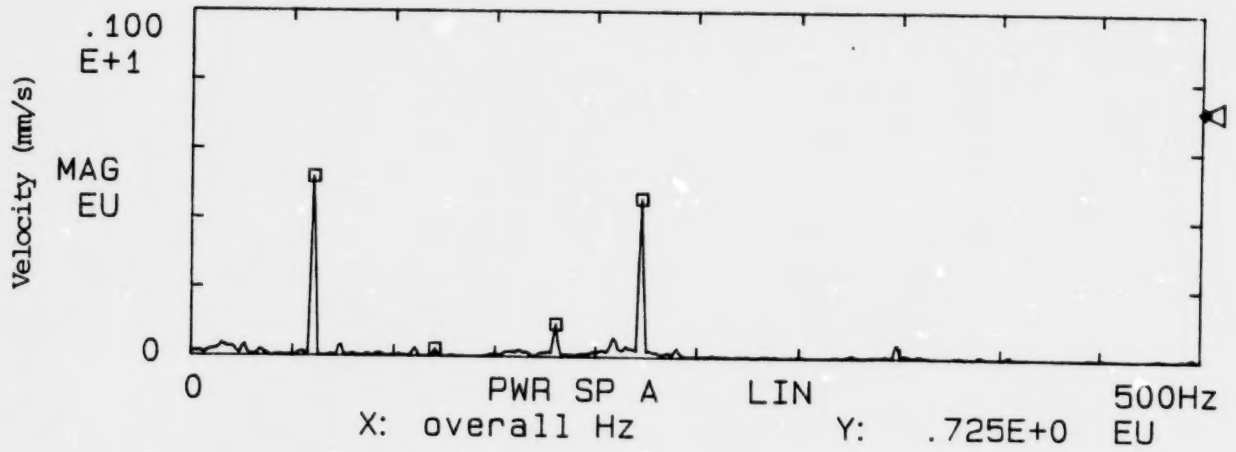
FIGURE 8

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - BOTTOM OF MOTOR CASING VELOCITY
AXIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#1 UNCOUPLED BOT- AXIAL VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.520E+0	EU
2	120.00	.233E-1	
3	180.00	.977E-1	
4	222.50	.462E+0	
5			
6			
7			
8			
9			
10			



00: 43

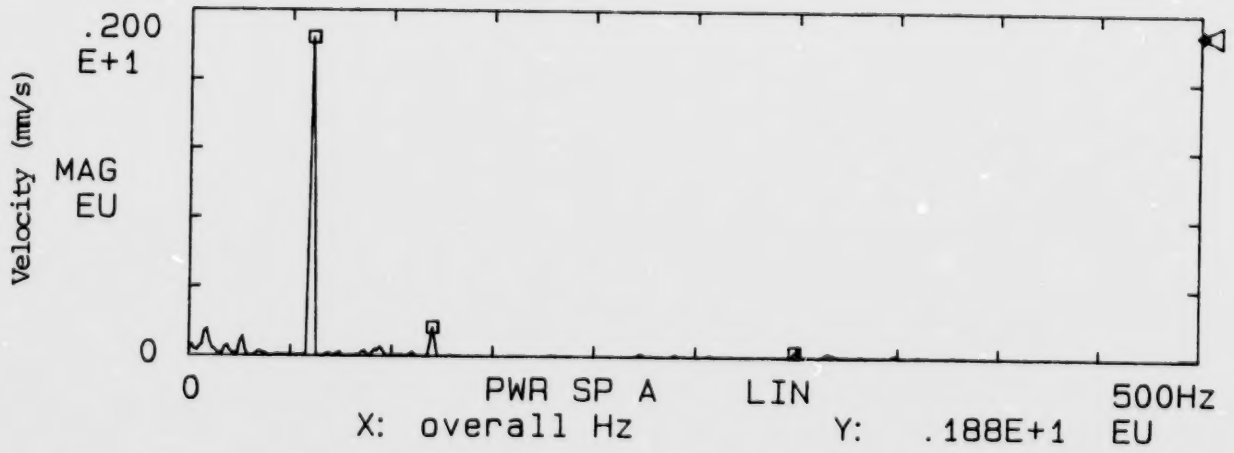
FIGURE 9

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - TOP OF MOTOR CASING VELOCITY
LOC. #1 RADIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#2 UNCOUPLED TOP- (HARD) VEL
500Hz A: AC/ 2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.185E+1	EU
2	120.00	.170E+0	
3	298.75	.334E-1	
4			
5			
6			
7			
8			
9			
10			



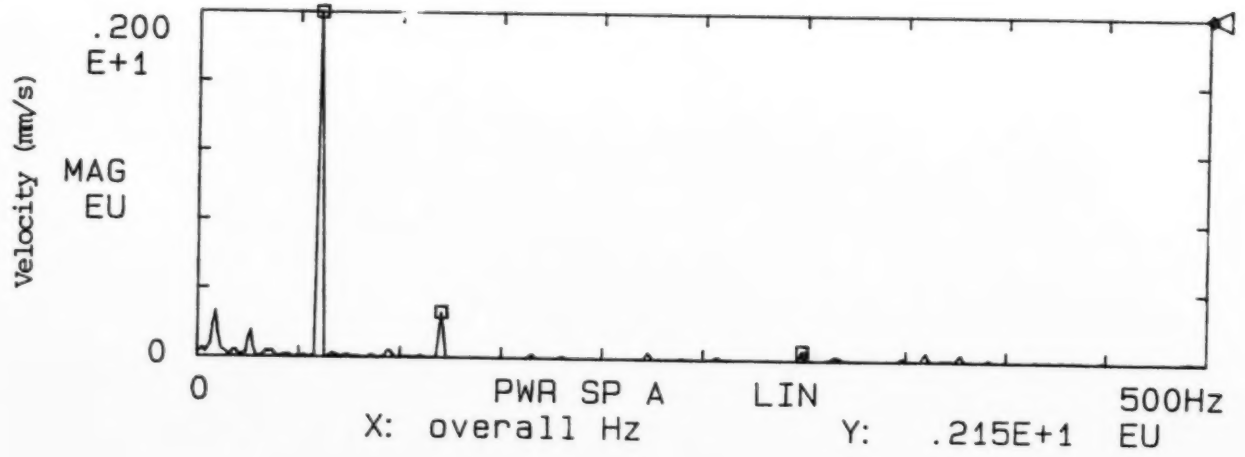
00: 14

FIGURE 10

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - TOP OF MOTOR CASING VELOCITY
LOC. #2 TANGENTIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#2 UNCOUPLED TOP- (SOFT) VEL
500Hz A: AC/ 2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.209E+1	EU
2	120.00	.268E+0	
3	298.75	.624E-1	
4			
5			
6			
7			
8			
9			
10			



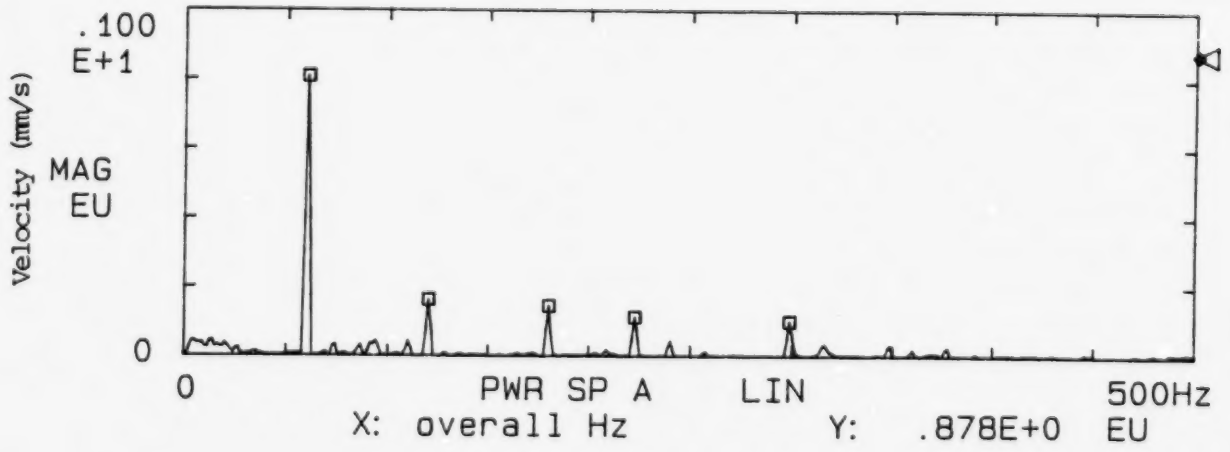
00: 16

FIGURE 11
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - TOP OF MOTOR CASING VELOCITY
AXIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#2 UNCOUPLED TOP- AXIAL VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.812E+0	E'!
2	120.00	.166E+0	
3	180.00	.146E+0	
4	222.50	.115E+0	
5	298.75	.102E+0	
6			
7			
8			
9			
10			



00: 21

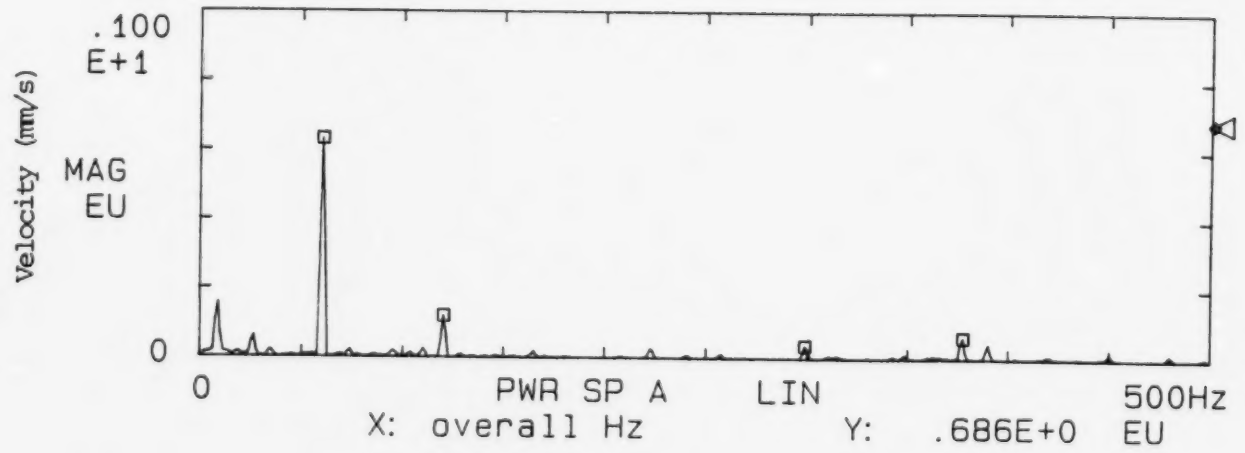
FIGURE 12

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - BOTTOM OF MOTOR CASING VELOCITY
N-S DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#2 UNCOUPLED BOT- (SOFT) VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.636E+0	EU
2	120.00	.123E+0	
3	298.75	.383E-1	
4	377.50	.654E-1	
5			
6			
7			
8			
9			
10			



00: 42

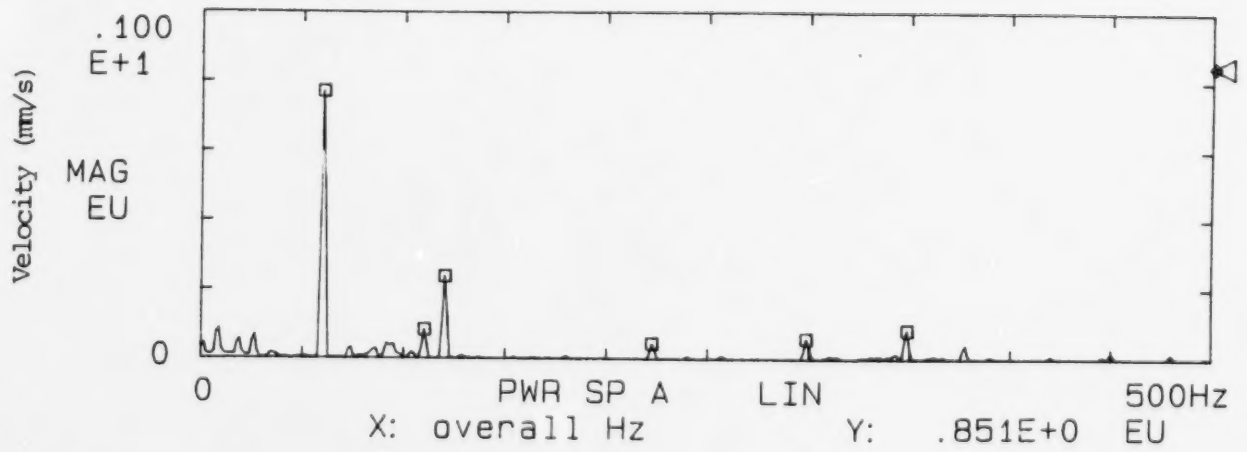
FIGURE 13

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - BOTTOM OF MOTOR CASING VELOCITY
E-W DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#2 UNCOUPLED BOT- (HARD) VEL
500Hz A: AC/ 2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.777E+0	EU
2	110.00	.857E-1	
3	120.00	.239E+0	
4	222.50	.452E-1	
5	298.75	.621E-1	
6	348.75	.857E-1	
7			
8			
9			
10			



00: 33

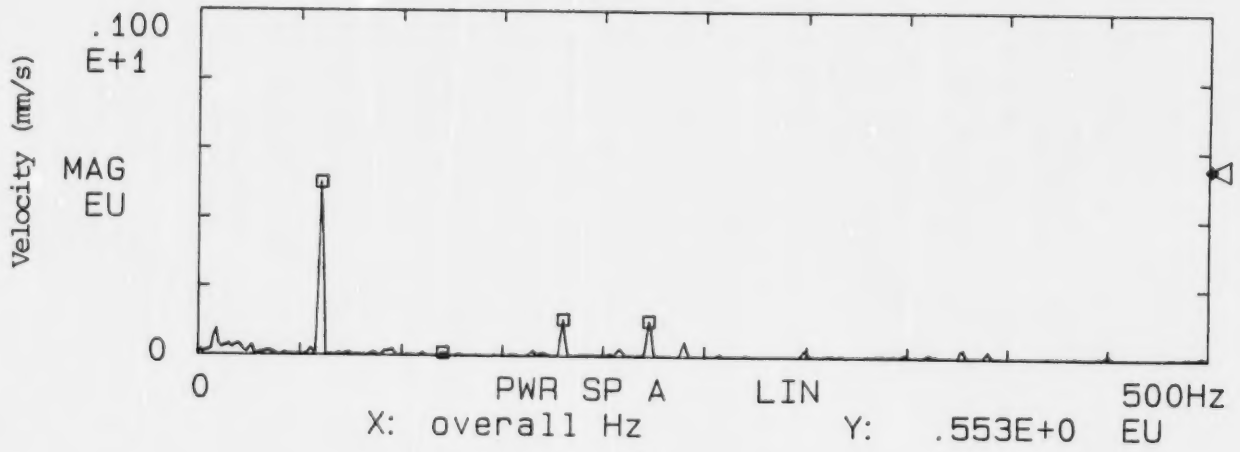
FIGURE 14

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - BOTTOM OF MOTOR CASING VELOCITY
AXIAL DIRECTION (MOTOR UNCOUPLED)

PICK U#8 PHT PRESS. PM#2 UNCOUPLED BOT- AXIAL VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.507E+0	EU
2	120.00	.121E-1	
3	180.00	.108E+0	
4	222.50	.106E+0	
5			
6			
7			
8			
9			
10			



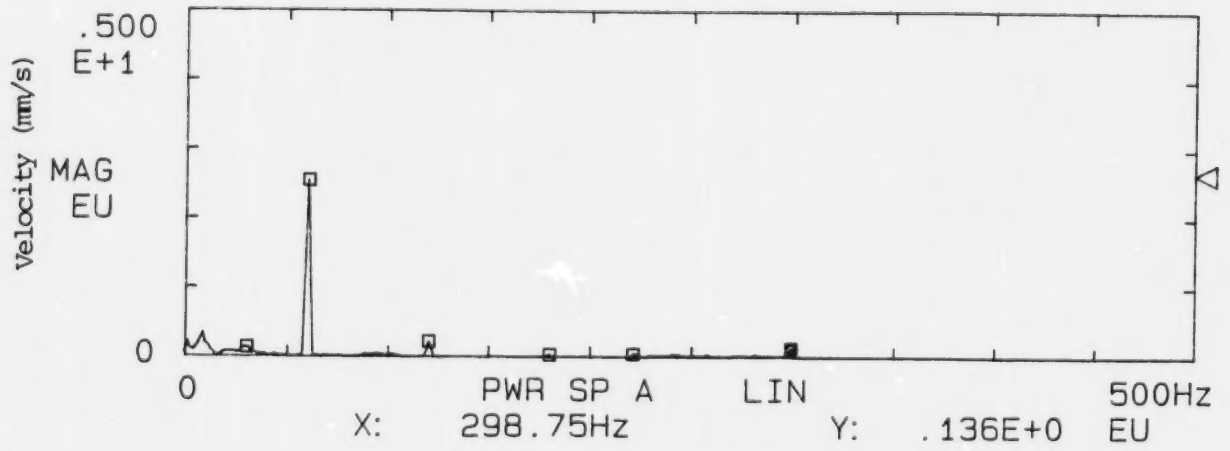
00: 45

FIGURE 15
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - TOP OF MOTOR CASING VELOCITY
LOC. #1 RADIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED T.O.M. (N.E.) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	30.00Hz	.152E+0	EU
2	60.00	.257E+1	
3	120.00	.226E+0	
4	180.00	.354E-1	
5	221.25	.503E-1	
6	298.75	.136E+0	
7			
8			
9			
10			



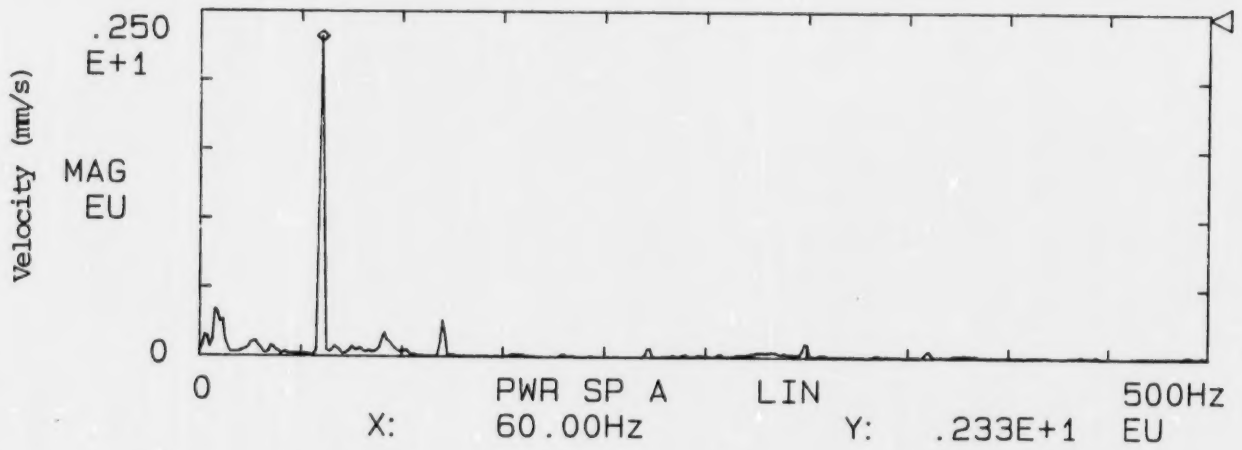
00: 02

FIGURE 16

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - TOP OF MOTOR CASING VELOCITY
LOC. #2 TANGENTIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED T.O.M. (S.E.) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	30.00Hz	.659E-1	EU
2	60.00	.233E+1	
3	120.00	.273E+0	
4	180.00	.297E-1	
5	221.25	.682E-1	
6	298.75	.108E+0	
7			
8			
9			
10			



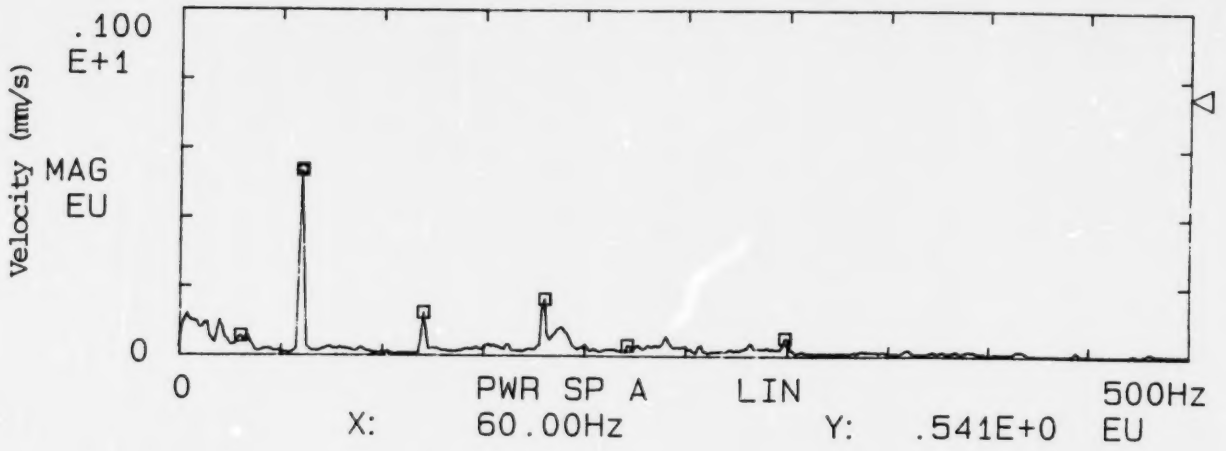
00: 05

FIGURE 17
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - TOP OF MOTOR CASING VELOCITY
AXIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED T.O.M. (AX.) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	30.00Hz	.578E-1	EU
2	60.00	.541E+0	
3	120.00	.126E+0	
4	180.00	.168E+0	
5	221.25	.313E-1	
6	298.75	.534E-1	
7			
8			
9			
10			



00: 10

FIGURE 18

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - BOTTOM OF MOTOR CASING VELOCITY
N-S DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED BOT (S) VEL MM/S
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	28.75Hz	.401E-1	EU
2	60.00	.102E+1	
3	91.25	.108E+0	
4	120.00	.149E+0	
5	180.00	.703E-1	
6	221.25	.364E-1	
7	300.00	.596E-1	
8			
9			
10			

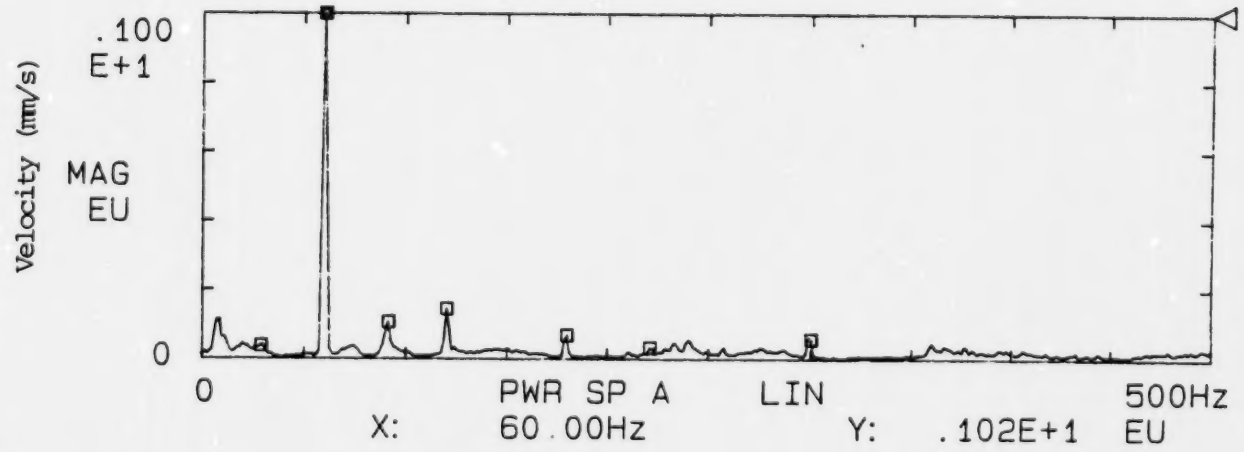


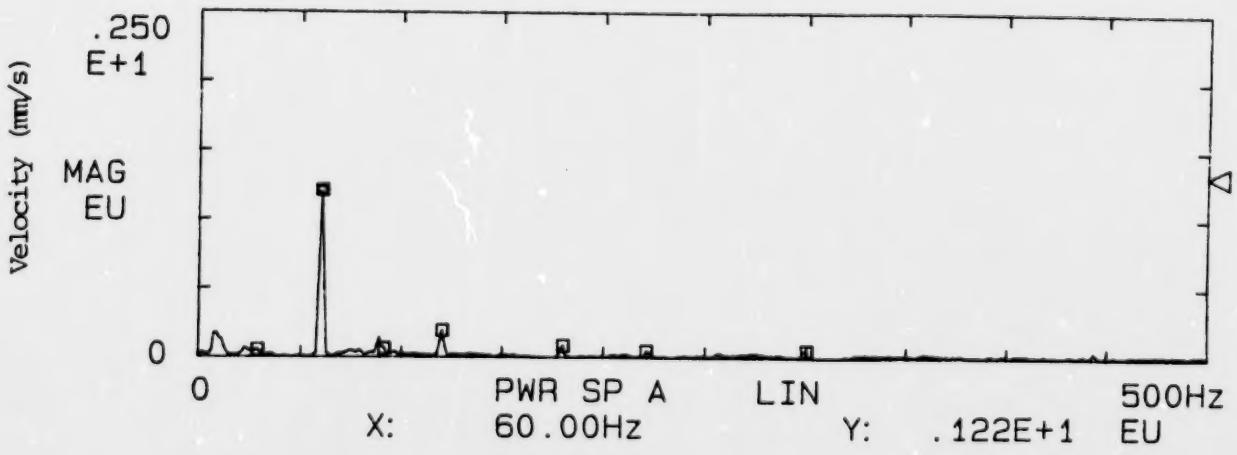
FIGURE 19
87-247

02: 43

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - BOTTOM OF MOTOR CASING VELOCITY
E-W DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED BOT (W) VEL MM/S
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	28.75Hz	.603E-1	EU
2	60.00	.122E+1	
3	91.25	.650E-1	
4	120.00	.199E+0	
5	180.00	.902E-1	
6	221.25	.487E-1	
7	300.00	.550E-1	
8			
9			
10			



02: 45

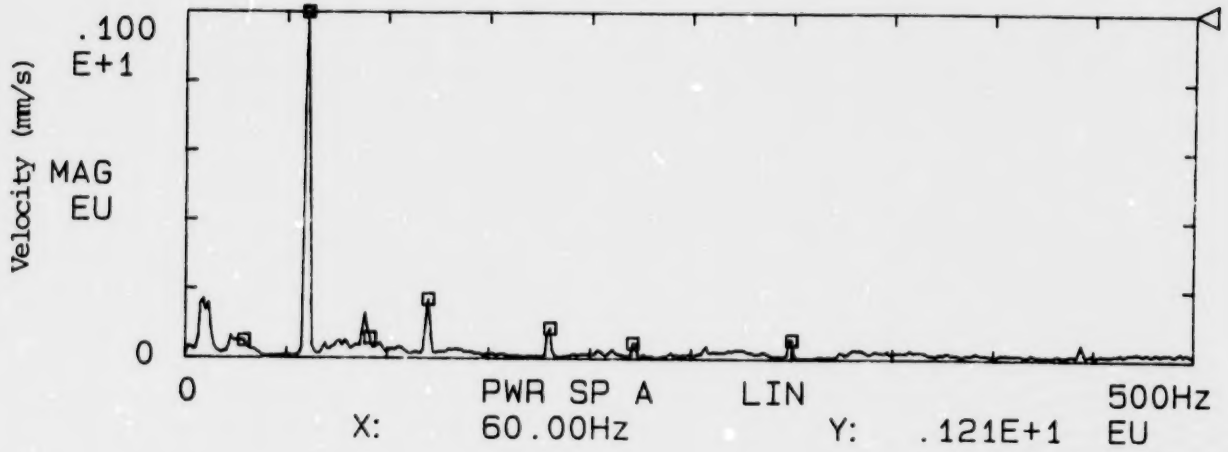
FIGURE 20

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - BOTTOM OF MOTOR CASING VELOCITY
AXIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED BOT (AX.) VEL MM/S
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	28.75Hz	.507E-1	EU
2	60.00	.121E+1	
3	91.25	.608E-1	
4	120.00	.173E+0	
5	180.00	.898E-1	
6	221.25	.479E-1	
7	300.00	.590E-1	
8			
9			
10			



02: 41

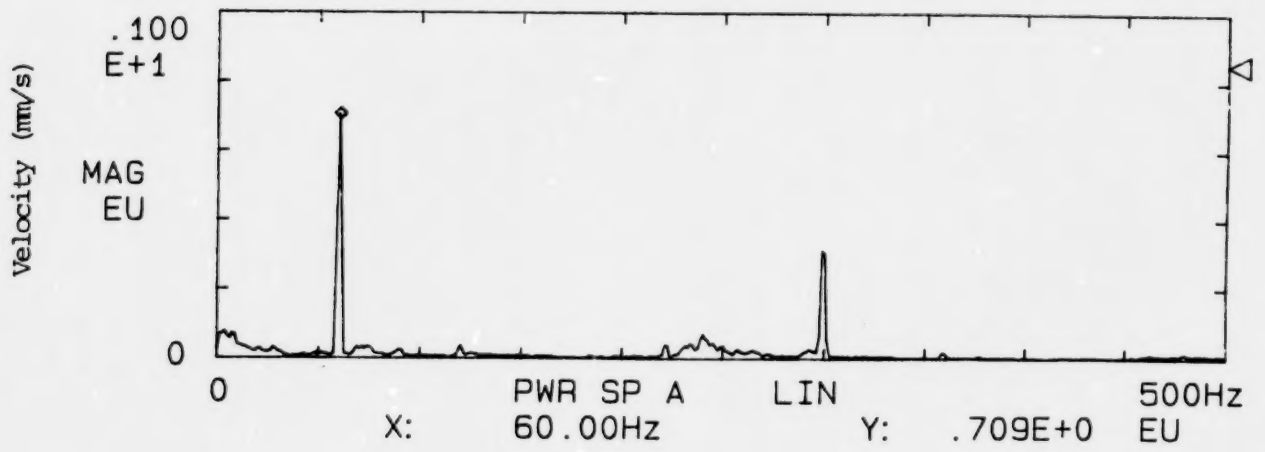
FIGURE 21

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - PUMP STOOL BASE VELOCITY
N-S DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED PUMP (S.) VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	20.00Hz	.287E-1	EU
2	60.00	.709E+0	
3	70.00	.286E-1	
4	120.00	.398E-1	
5	180.00	.452E-2	
6	221.25	.433E-1	
7	298.75	.313E+0	
8			
9			
10			



02: 22

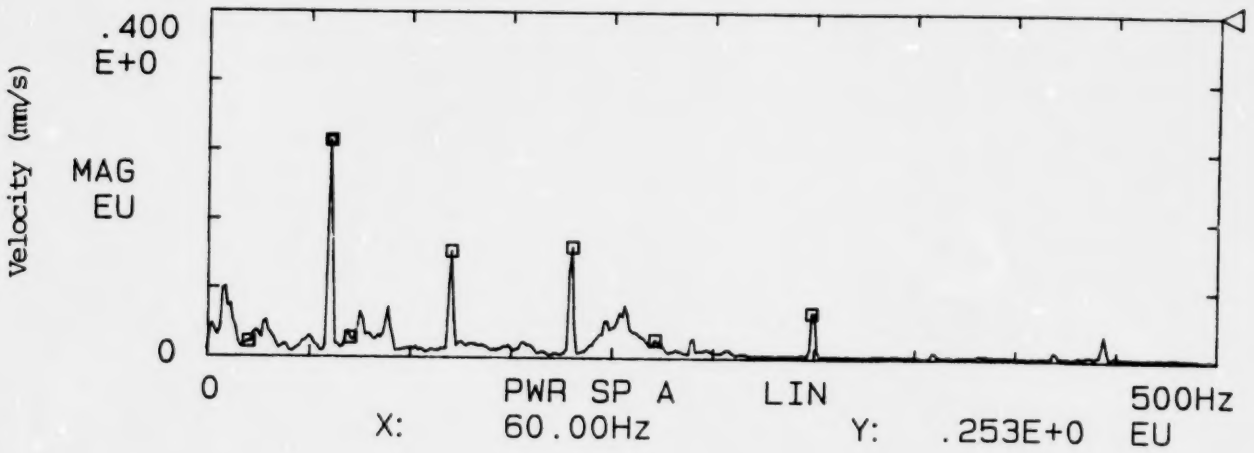
FIGURE 22

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - PUMP STOOL BASE VELOCITY
E-W DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED PUMP (W.) VEL mm/s
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	20.00Hz	.177E-1	EU
2	60.00	.253E+0	
3	70.00	.231E-1	
4	120.00	.124E+0	
5	180.00	.129E+0	
6	221.25	.216E-1	
7	298.75	.542E-1	
8			
9			
10			



02: 23

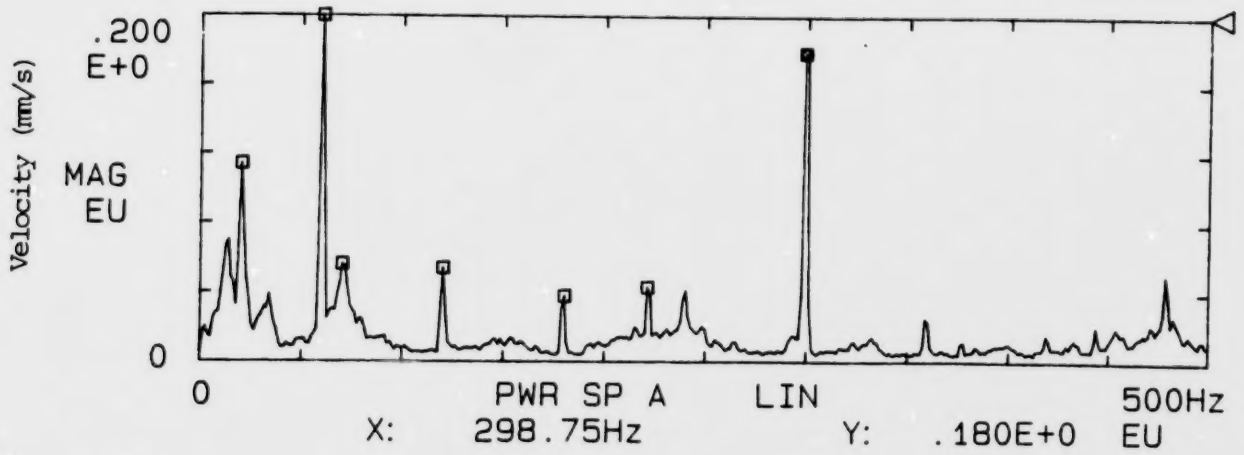
FIGURE 23

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #1 - PUMP STOOL BASE VELOCITY
AXIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#1 COUPLED PUMP AX. VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	20.00Hz	.115E+0	EU
2	60.00	.210E+0	
3	70.00	.566E-1	
4	120.00	.548E-1	
5	180.00	.383E-1	
6	221.25	.434E-1	
7	298.75	.180E+0	
8			
9			
10			



02: 19

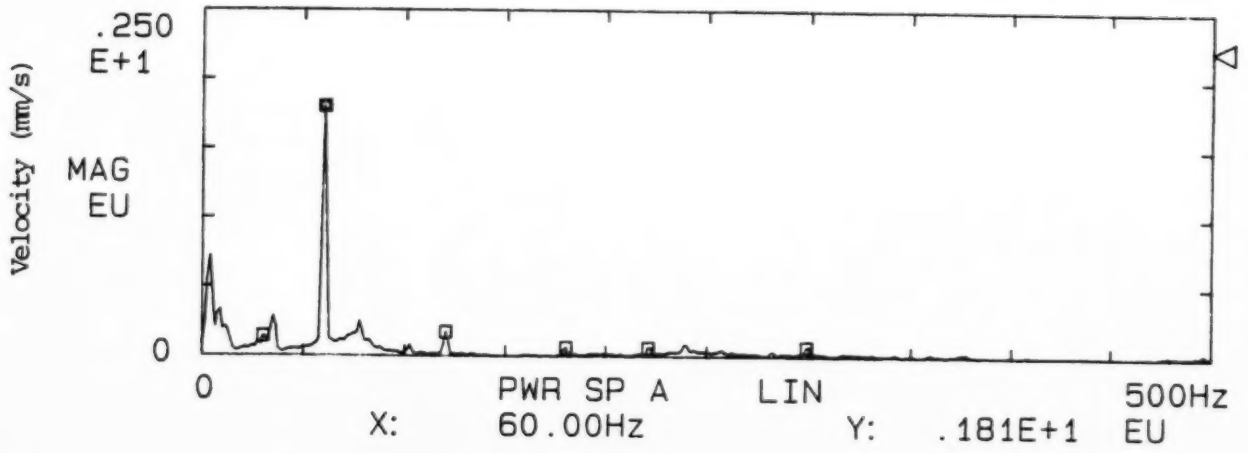
FIGURE 24

87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - TOP OF MOTOR CASING VELOCITY
LOC. #1 RADIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED T.O.M. (N.W.) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	30.00Hz	.143E+0	EU
2	60.00	.181E+1	
3	120.00	.178E+0	
4	180.00	.662E-1	
5	221.25	.654E-1	
6	298.75	.773E-1	
7			
8			
9			
10			



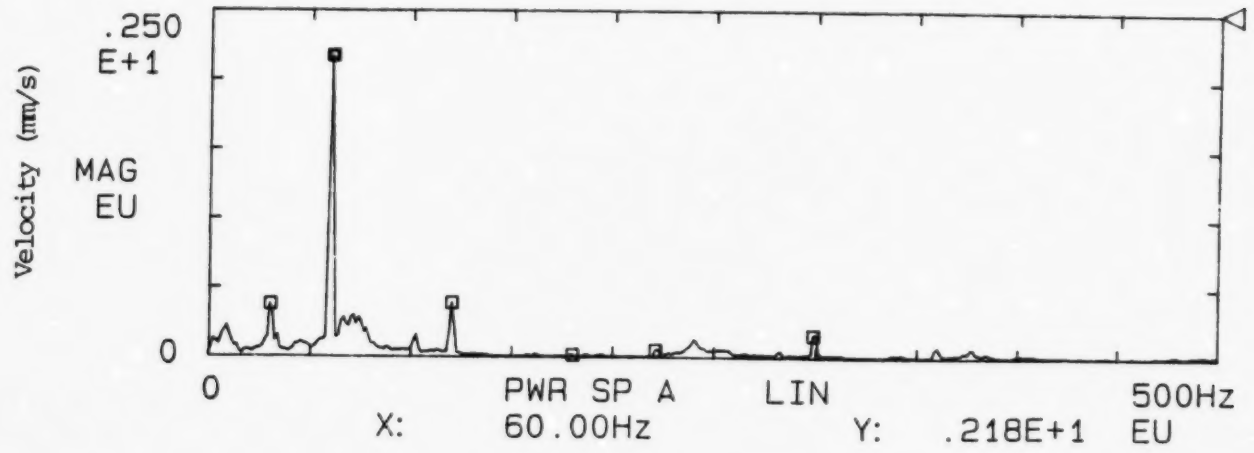
00: 18

FIGURE 25
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - TOP OF MOTOR CASING VELOCITY
LOC. #2 TANGENTIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED T.O.M. (S.W.) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	30.00Hz	.386E+0	EU
2	60.00	.218E+1	
3	120.00	.399E+0	
4	180.00	.210E-1	
5	221.25	.563E-1	
6	298.75	.169E+0	
7			
8			
9			
10			



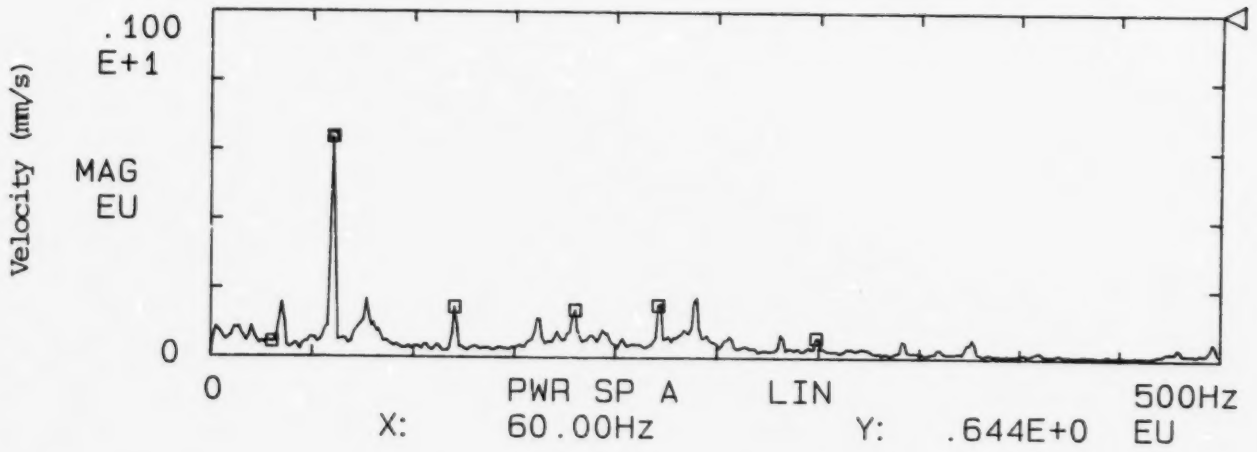
00: 20

FIGURE 26
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - TOP OF MOTOR CASING VELOCITY
AXIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED T.O.M. (AX.) VEL
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	30.00Hz	.455E-1	EU
2	60.00	.644E+0	
3	120.00	.150E+0	
4	180.00	.141E+0	
5	221.25	.155E+0	
6	298.75	.601E-1	
7			
8			
9			
10			



00: 16

FIGURE 27
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - BOTTOM OF MOTOR CASING VELOCITY
N-S DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED BOT (S) VEL MM/S
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.940E+0	EU
2	120.00	.293E+0	
3	162.50	.131E+0	
4	222.50	.643E-1	
5	240.00	.143E+0	
6	300.00	.168E+0	
7			
8			
9			
10			

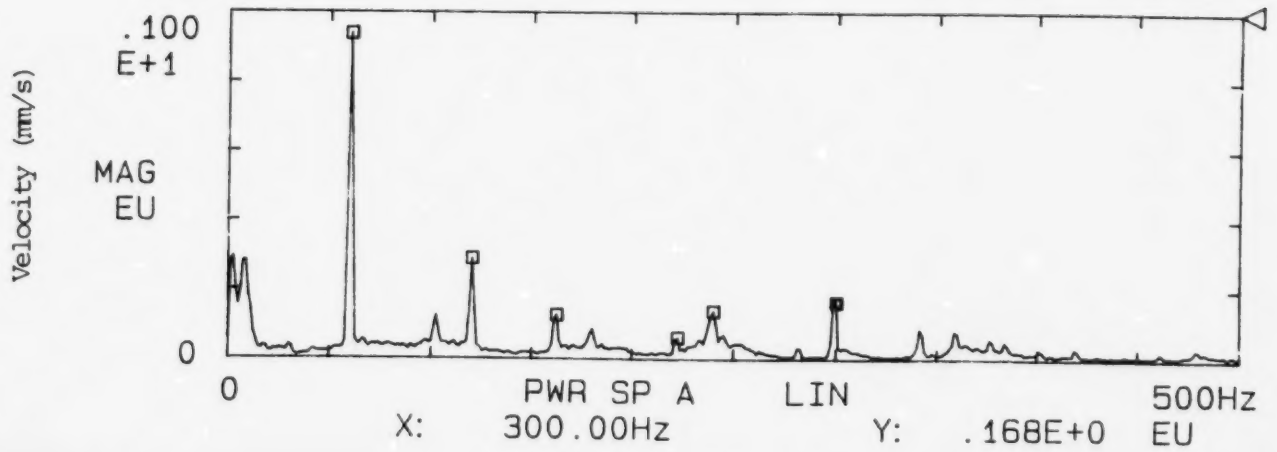


FIGURE 28

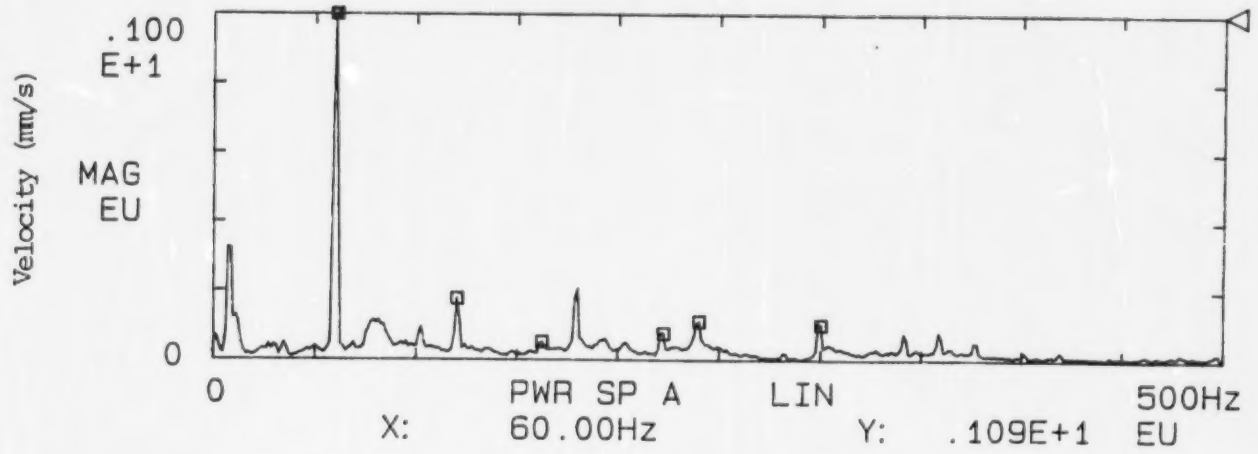
87-247

02: 53

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - BOTTOM OF MOTOR CASING VELOCITY
E-W DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED BOT (W) VEL MM/S
500Hz A: AC/0.5V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.109E+1	EU
2	120.00	.180E+0	
3	162.50	.556E-1	
4	222.50	.814E-1	
5	240.00	.114E+0	
6	300.00	.106E+0	
7			
8			
9			
10			



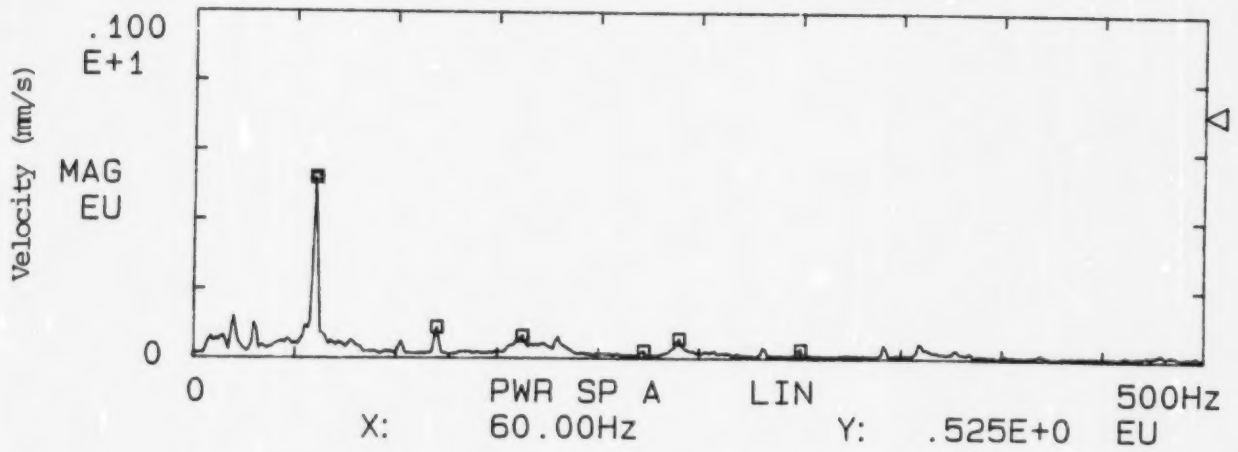
02: 55

FIGURE 29
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - BOTTOM OF MOTOR CASING VELOCITY
AXIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED BOT (AX.) VEL MM/S
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.525E+0	EU
2	120.00	.932E-1	
3	162.50	.660E-1	
4	222.50	.242E-1	
5	240.00	.588E-1	
6	300.00	.261E-1	
7			
8			
9			
10			



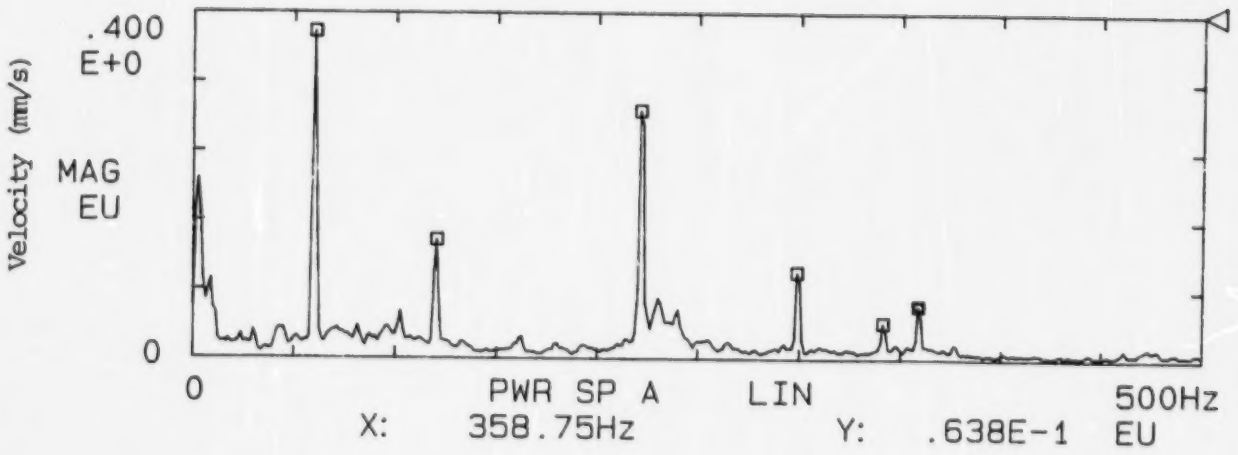
02: 57

FIGURE 30
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - PUMP STOOL BASE VELOCITY
N-S DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED PUMP S. VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.380E+0	EU
2	120.00	.138E+0	
3	221.25	.288E+0	
4	298.75	.102E+0	
5	341.25	.436E-1	
6	358.75	.638E-1	
7			
8			
9			
10			



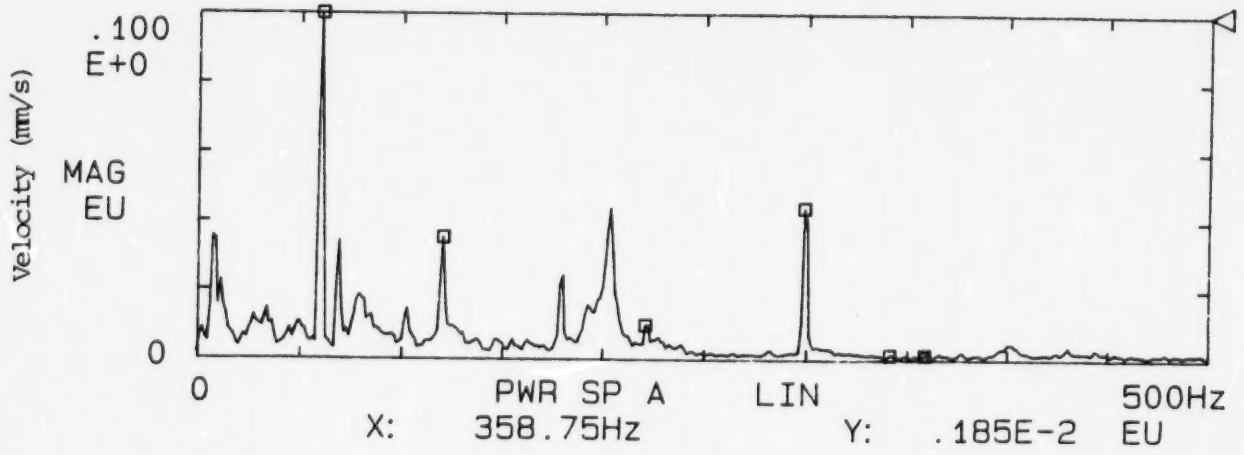
00: 28

FIGURE 31
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - PUMP STOOL BASE VELOCITY
E-W DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED PUMP W. VEL
500Hz A: AC/50mV B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.111E+0	EU
2	120.00	.358E-1	
3	221.25	.101E-1	
4	298.75	.445E-1	
5	341.25	.187E-2	
6	358.75	.185E-2	
7			
8			
9			
10			



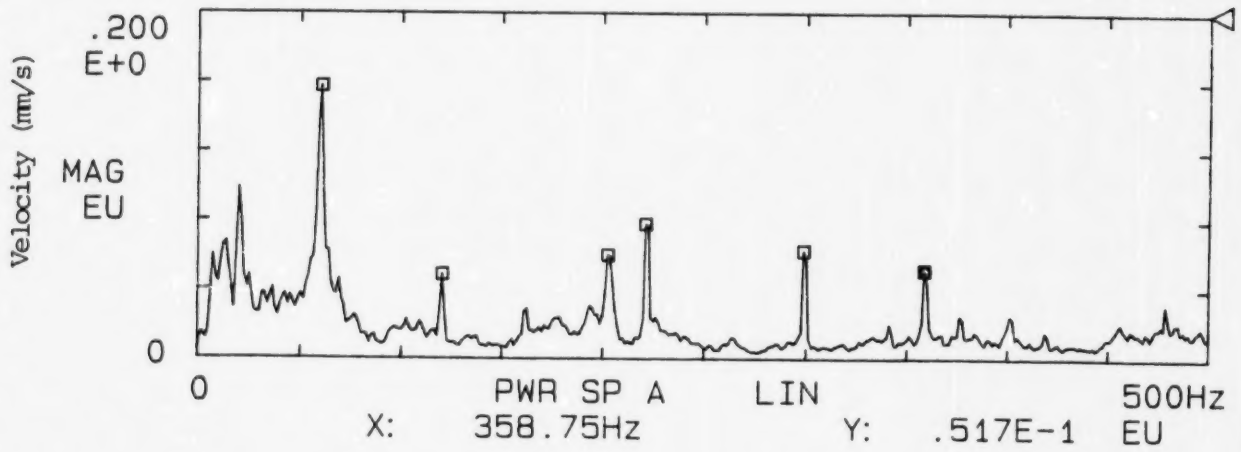
00: 30

FIGURE 32
87-247

PICKERING NGS UNIT 8 PHT PRESSURIZING PUMPSET #2 - PUMP STOOL BASE VELOCITY
AXIAL DIRECTION (PUMP-MOTOR COUPLED)

PICK U#8 PHT PRESS. PM#2 COUPLED PUMP AX. VEL
500Hz A: AC/0.2V B: AC/ 50V S.SUM 16/16 DUAL 1k

	PWR SPECTRUM	ChA	
1	60.00Hz	.158E+0	EU
2	120.00	.494E-1	
3	202.50	.600E-1	
4	221.25	.784E-1	
5	298.75	.628E-1	
6	358.75	.517E-1	
7			
8			
9			
10			



00: 37

FIGURE 33

87-247

DISTRIBUTION

Mr. R.O. Schuelke Jr.	Pickering NGS
Mr. K.H. Talbot	Pickering NGS
Mr. P.F. Tremblay	Pickering NGS 'B'
Mr. V. Hrynyk	Pickering NGS 'B'
Mr. J. Bailie	Pickering NGS 'B'
Mr. L. Henderson	Pickering NGS 'B'
--Mr. J. Graham	Tech & Train Serv, A7G2
Mr. T. Loewen	Mechanical Research
Mr. F. Perricone	Mechanical Research
Mr. N. Jagan (2)	Mechanical Research
Mr. P. Hoogendam	Mechanical Research
Public Reference Centre	
Editorial Section (2)	
Office Copies (2)	
Extra Copies (2)	
Section Copy, KR277	

-- Executive Summary only

-last page-